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BIC Lighter Lab

Purpose: The purpose of this lab is to experimentally determine the molar mass of a sample of butane (C_4H_{10}) gas. Using the ideal gas law and the data collected, the experimental molar mass of the butane (C_4H_{10}) can be determined and compared to the calculated molar mass of butane (C_4H_{10}) which is 58.1 g/mol.

Materials:

- Sink
- Butane Lighter
- 100mL Graduated Cylinder (Glass)
- Electronic Balance
- Thermometer

Pre lab Questions:

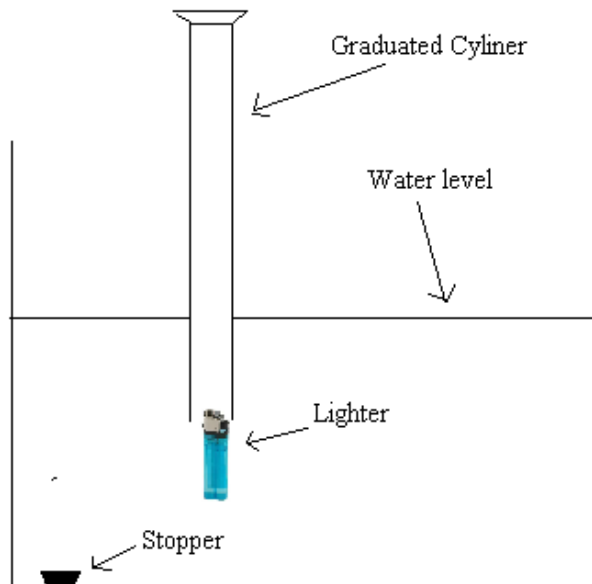
1. What is the balanced equation for the combustion of butane gas?
2. If the density of a gas is found to be 717g/L at 25°C and 1031atm, what would the molar mass of the gas be?
3. If 40.0g of the gas from problem 2 was placed under STP conditions, what is the new density of the gas? (density is g/L)

Procedure:

1. Fill a bucket 2/3 with water. (Let it sit so water temp. = room temp.)
2. Put the lighter under the water for about 10 seconds, then take out of water, **dry it off completely** and take the mass of the lighter.
3. Fill the graduated cylinder with water (make sure there are no air bubbles in the cylinder)
4. Invert the graduated cylinder into bucket of water.
5. Take the butane lighter and hold it under the Graduated cylinder. (Diagram 1)
6. Release 75ml of the butane (C_4H_{10}) gas into the graduated cylinder by holding down the black 'button' at the top of the lighter.
7. Raise the level of the graduated cylinder to make sure the water level in the graduated cylinder matches the water level of the water in the bucket.
8. Record the volume of the butane gas (ml)
9. Take the graduated cylinder out of the water. Aim the mouth of the graduated cylinder away from your face and light it with the Bunsen burner.
10. Dry the lighter and take the mass of the lighter again.
11. Wait 5 min and take mass again of lighter.
12. Determine and record the room temperature using the thermometer.
13. Record the pressure of the room written on the board.

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Diagram 1



| Data Table (Measurements and Calculations) | |
|--|--|
| Initial Mass of Lighter before (g) | |
| Mass of Lighter after step #2 (g) | |
| Mass of Lighter after step #11(g) | |
| Mass of butane released (g) | |
| Volume of butane (ml) | |
| Volume of butane (L) | |
| Room Temperature (°C) | |
| Room Temperature (K) | |
| Air Pressure (atm.) | |
| Water Vapor Pressure (atm.) | |
| Pressure of Butane Gas (atm.) | |

Conclusion Questions:

1. Using the ideal gas law ($PV=nRT$), determine the molar mass of the sample of gas collected ($MM = g/mol$).
2. If the actual molar mass of the butane gas collected is 58.1 g/mol, using your experimental value calculated in the lab, what is the percent error of your experiment?
Percent Error = $\frac{\text{Actual} - \text{Experimental}}{\text{Actual}} \times 100$
3. How accurate was your experiment, if you had error what do you think was the cause of it?
4. Why did you make sure that the level of the water in the graduated cylinder was at the same level as the water surrounding the graduated cylinder in the sink?

Bonus: Record the color that the butane gas emitted when it was lit on fire and explain why the butane gas lit was a different color than most fires that you observe.